DETAILED ACTION

Response to Amendments

Claim Status

1. Claims 1-7 of US Application 10/585,409, filed 7/7/2006, are presented for examination.

Claim Interpretation

2. As per claims 1 and 4, Examiner interprets the phrase "a partial set of control values" as one or more control values belonging to the set of all control values.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims **1-7** are rejected under 35 U.S.C. 103(a) as being unpatentable over ***Kawai et al(US Pat. No. 5,313,395)(hereinafter as Kawai)*** in view of ***Santori et al (US Pat. No. 7,076,411 B2)(hereinafter as Santori)***, ***Mizushina et al (US Pat. No. 4,984,988)*** and further in view of **Hanselmann (Automotive Control: From Concept to Experiment to Product, 1996)**.

Kawai discloses: As per **Claim 1**. An engine transition test instrument comprising:

a virtual engine tester for simulating a transition state of a virtual engine in which a rotational speed or torque of the virtual engine changes with time **(col. 6, lines 46-57, fig. 3 and fig. 4, teaches rotating speed is measured and modeled)**; and

an actual engine transition tester for conducting actual transition testing using an actual engine **(col. 3, lines 65 to col. 4, line 5 and fig. 1, teaches a rotating speed adjusting means to adjust the engine speed of the internal combustion engine and a control means which calculates a control value.)**; and

an actual controller for controlling the actual engine **(col. 3, lines 65 to col. 4, line 5 and fig. 1, teaches a rotating speed adjusting means to adjust the engine speed of the internal combustion engine and a control means which calculates a control value.)**,

wherein the virtual engine tester comprises:

a simulator for simulating the behavior of the virtual engine by creating a transition engine model based on data obtained by driving the actual engine while changing a value of at least one controlled factor **(col. 5, lines 46-59 and col. 6, lines 35-42 and lines 46-59, teaches an autoregressive moving average model is utilized for the model of a system which controls the idling speed of the engine. The constants for the model are determined experimentally by means of a step response. It would have been obvious to one of ordinary skill in the art to drive an engine to gather experimental data for better accuracy.)**;

a virtual controller that emulates the actual controller and supplies an engine control signal to the tester simulator **(col. 3, lines 66 to col. 4, line 5 and col. 19, lines 30-35, teaches a control means)**, and

the actual engine transition tester comprises a means for switching to the engine the control signal output from the virtual controller **(i.e. dynamic model)**, and supplying the signal to the actual engine **(col. 3, lines 26-37, col. 21, lines 60-63 and col. 23, lines 57-62, teaches a dynamic model to control the idling speed of an internal combustion engine.)** for evaluation **(i.e. the phrase "for evaluation" is construed as statement of intended use and therefore not given patentable weight. See MPEP § 2106.)**.

Kawai does not expressly disclose a simulator for simulating behavior of an engine.
Santori, however, discloses a simulator for simulating behavior of an engine **(col.4 47-52, 58-63 and fig. 2A, teaches simulation of automobile coupled to control unit)**.
Kawai and Santori are analogous art because they are from similar problem solving area of designing control unit. At the time of the invention it would have been obvious to person of ordinary skill in the art to utilize the principles of testing control unit using hardware-in-the-loop simulation as discussed by Santori to test the unit to control idling speed of an engine for purpose of testing response of a control unit **(Santori: col. 58-64)**.
Although Kawai and Santori disclose a controller, they do not expressly disclose the controller having a predetermined control map, associated control factor and a set of control values, to output engine control signals; the engine control signals output from the control map of the controller; and control signal generated from a partial set of control values associated with its control factor.

Mizushina, however, teaches a controller having a predetermined control map, associated control factor **(i.e. torque)** and a set of control values **(i.e. opening angle of the throttle valve of an engine or an intake manifold pressure of an engine)**, to output engine control signals **(Fig. 2, item 11, col. 3, lines 11-31, teaches simulated engine characteristic control system comprising … an engine characteristic generator for generating a torque command signal according to predetermined engine revolution/torque characteristic curves)**; and engine control signals output from the control map of the controller **(col. 3, lines 32-45, teaches simulation control system includes means for transducing the torque command signal to an electric current command signal according to a predetermined torque/current characteristic curve. See also Fig. 2 and col. 4, lines 37-58, teaches current I_1 output from transducer 11.)**; and control signal generated from a partial set of control values associated with its control factor **(col. 4, lines Fig. 2 and col. 4, lines 37-50, discloses torque command signal is process into an electric current command signal in accordance with a torque/current characteristic curve of a DC motor)**.

Kawai, Santori, and Mizushina are analogous art because they are from similar problem solving area of designing control unit. At the time of the invention it would have been obvious to person of ordinary skill in the art to utilize the principles of testing control unit using hardware-in-the-loop simulation as discussed by Santori to test the unit to control idling speed of an engine as discussed by Kawai in combination with a transducer with predetermined characteristics as discussed by Mizushina for purpose of testing response of a control unit **(Santori: col. 58-64)**.

Kawai, Santori, and Mizushina do not expressly disclose:

> the outputs from the actual controller are used for the controlled factors that are not subject to the evaluation, and the outputs from the virtual controller are used for the simulation as an engine control signal with respect to the controlled factors that are subjected to the evaluation.

Hanselmann discloses (see sections entitled: **The Virtual ECU** and **Bypass: Leaving a Real ECU in the Loop (pg. 131):**

> …For projects where a production ECU exists that performs a large portion of the whole control function already, just not the new ones under development, it is very reasonable to reuse the existing ECU in the following way (figure **3). The** existing ECU keeps doing all I/O except such I/O that was not required before **and** will therefore be provided by the RCP hardware. The existing ECU also keeps executing startup code, safety code, diagnostics, and communication. However, those functions of the ECU code that are subject to the new development are off-loaded to the RCP processor (DSP for example)…

Note the RCP provides for virtual ecu functions as per the section entitled, "**The Virtual ECU**". Kawai, Santori, Mizushina and Hanselmann are analogous art because they are from similar problem solving area of designing control unit. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Kawai, Santori, and Mizushina with **Hanselmann** because, as noted earlier, **Hanselmann** discloses:

> "……For projects where a production ECU exists that performs a large portion of the whole control function already, just not the new ones under development, it is very reasonable to reuse the existing ECU in the following way (figure 3)…"

Santori discloses: As per **Claim 2**. (Previously Presented) The engine transition test instrument according to claim 1, wherein the virtual engine tester further comprises a control value operation means for supplying a control value for a controlled factor to the virtual controller **(see fig. 10, item 427 and 429, col. 5, lines 17-26, col. 21, lines 61-67, target device may execute control algorithm to control physical system)**, to cause simulation results by the simulator to be displayed on display means **(see fig. 5, items 310, 312, and 314, col. 17, lines 52-59, teaches a GUI to control a hardware-in-the-loop simulation)**.

Kawai discloses: As per **Claim 3**. (Previously Presented) The engine transition test instrument according to claim 1, wherein the actual controller is configured so as to perform feed back control with referencing the output value of the actual engine **(col. 3, line 60 to col. 4, line 5 and fig. 1, teaches adjusting rotating speed of internal combustion engine using a feedback loop)** and the instrument comprises a means for correcting the output value from the actual engine that has changed when the engine control signal output from the virtual controller was supplied to the actual engine to a value before such a change was made, and feeding back the corrected value to the actual controller **(col. 4, lines 5-26, teaches control means is provided with first control value setting means which sets a state variable according to detected rotating speed by previous operation timing. A selecting means is disclosed to select the desired first control value or second control value)**.

Kawai discloses: As per **Claim 4**. (Currently Amended) An engine transition test method comprising:

a first step of creating a transition engine model based on data obtained by driving an actual engine having a controller while changing a value of at least one controlled factor in a transition state in which an engine rotational speed or torque changes with time (**col. 5, lines 46-59 and col. 6, lines 35-42 and lines 46-59, teaches an autoregressive moving average model is utilized for the model of a system which controls the idling speed of the engine. The constants for the model are determined experimentally by means of a step response. It would have been obvious to one of ordinary skill in the art to drive an engine to gather experimental data for better accuracy.**);

a second step of emulating the actual controller, generating an engine control signal based on a control value for controlled factor (**col. 3, lines 66 to col. 4, line 5 and col. 19, lines 30-35, teaches a control means**); and

a third step of switching to the engine the control signal generated in the second step, and supplying the signal to the actual engine (**col. 3, lines 26-37, col. 21, lines 60-63 and col. 23, lines 57-62, teaches a dynamic model to control the idling speed of an internal combustion engine.**) for evaluation (**i.e. the phrase "for evaluation" is construed as statement of intended use and therefore not given patentable weight. See MPEP § 2106.**).

Kawai does not expressly disclose operating the transition engine model as a virtual engine. Santori, however, discloses operating the transition engine model as a virtual engine (**col.4 47-52, 58-63 and fig. 2A, teaches simulation of automobile coupled to control unit**).

Kawai and Santori are analogous art because they are from similar problem solving area of designing control unit. At the time of the invention it would have been obvious to person of ordinary skill in the art to utilize the principles of testing control unit using hardware-in-the-loop simulation as discussed by Santori to test the unit to control idling speed of an engine for purpose of testing response of a control unit **(Santori: col. 58-64)**.

Although Kawai and Santori disclose a controller, they do not expressly disclose the controller having a predetermined control map, which includes a set of control values associated with a control factor, forming a virtual controller to output engine control signals; the engine control signals output from the controller; and an engine control signal based on a partial set of the control values for the controlled factor.

Mizushina, however, teaches a controller having a predetermined control map, which includes a set of control values **(i.e. opening angle of the throttle valve of an engine or an intake manifold pressure of an engine)** associated with a control factor **(i.e. torque)**, forming a virtual controller to output engine control signals **(Fig. 2, item 11, col. 3, lines 11-31, teaches simulated engine characteristic control system comprising ... an engine characteristic generator for generating a torque command signal according to predetermined engine revolution/torque characteristic curves)** and engine control signals output from the controller **(col. 3, lines 32-45, teaches simulation control system includes means for transducing the torque command signal to an electric current command signal according to a predetermined torque/current characteristic curve. See also Fig. 2 and col. 4, lines 37-58, teaches current I_1 output from transducer 11.)**; and an engine control signal based on a partial set of the control values for the controlled factor **(col. 4, lines Fig. 2 and col. 4, lines 37-50,**

discloses torque command signal is process into an electric current command signal in accordance with a torque/current characteristic curve of a DC motor).

Kawai, Santori, and Mizushina are analogous art because they are from similar problem solving area of designing control unit. At the time of the invention it would have been obvious to person of ordinary skill in the art to utilize the principles of testing control unit using hardware-in-the-loop simulation as discussed by Santori to test the unit to control idling speed of an engine as discussed by Kawai in combination with a transducer with predetermined characteristics as discussed by Mizushina for purpose of testing response of a control unit **(Santori: col. 58-64)**.

Note the RCP provides for virtual ecu functions as per the section entitled, **"The Virtual ECU".**

Kawai, Santori, and Mizushina do not expressly disclose:

> the outputs from the actual controller are used for the controlled factors that are not subject to the evaluation, and the outputs from the virtual controller are used for the simulation as an engine control signal with respect to the controlled factors that are subjected to the evaluation.

Hanselmann discloses (see sections entitled: **The Virtual ECU** and **Bypass: Leaving a Real ECU in the Loop (pg. 131):**

> …For projects where a production ECU exists that performs a large portion of the whole control function already, just not the new ones under development, it is very reasonable to reuse the existing ECU in the following way (figure **3)**. The existing ECU keeps doing all I/O except such I/O that was not required before **and** will therefore be provided by the RCP hardware. The existing ECU also keeps executing startup code, safety code, diagnostics, and communication. However, those functions of the ECU code that

> are subject to the new development are off-loaded to the RCP processor (DSP for example)…

Kawai, Santori, Mizushina and Hanselmann are analogous art because they are from similar problem solving area of designing control unit. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Kawai, Santori, and Mizushina with **Hanselmann** because, as noted earlier, **Hanselmann** discloses:

> "……For projects where a production ECU exists that performs a large portion of the whole control function already, just not the new ones under development, it is very reasonable to reuse the existing ECU in the following way (figure 3)…"

Kawai discloses: As per **Claim 5**. (Previously Presented) The engine transition test method according to claim 4, wherein the second step is repeated while changing the control value (**col. 3, lines 66 to col. 4, line 5 and col. 19, lines 30-35 fig. 1, teaches a control means which is in a loop that controls an engine. The loop allows the control value to be adjusted according to the state of the engine**), and the third step is performed when the output value from the virtual engine satisfies objective performance (**col. 5, lines 39-45**).

Kawai discloses: As per **Claim 6**. (Previously Presented) The engine transition test method according to claim 4, wherein the output value from the actual engine that has changed when the engine control signal generated in the second step was supplied to the actual engine (**col. 5, lines 39-45**) is corrected to a value before such a change was made, and the corrected value is fed back to the actual controller (**col. 1 61-65, col. 3, lines 66 to col. 4, line 5 and col. 19, lines 30-35 fig.**

1, teaches a control means which is in a loop that controls an engine. The loop allows the control value to be adjusted according to the state of the engine).

As per **claim 7**, note the rejection of claim 4 above. The instant claims recite substantially same limitations as the above-rejected claims and are therefore rejected under same prior-art teachings except for:

Kawai discloses: As per **Claim 7** (Currently Amended), a computer readable medium having instructions for causing an information processing system to perform the steps (**col. 5, lines 27-31, disclose ROM and RAM**).

Response to Arguments

4. Applicant's arguments filed 09/8/2011 have been fully considered but they are moot in view of the updated rejection applied in response to the amendment.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Hugh Jones whose telephone number is (571) 272-3781. The examiner can normally be reached on M-Th.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamini Shah can be reached on (571) 272-2279. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished

applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Hugh Jones/

Primary Examiner, Art Unit 2128